Rec'd PCT/PTO 10 SEP 2004
10/507256

FLUID PRODUCT DISPENSER

FIELD OF THE INVENTION

This invention has to do with dispensers for flowable materials, particularly viscous liquids such as gels and creams as typically used in pharmaceuticals, personal care and food products, and pasty materials such as toothpaste.

BACKGROUND OF THE INVENTION

Pastes and gels have conventionally been dispensed from hand-squeezed plastic tubes with rigid plastic nozzles. More recently, larger paste dispensers have had a dispensing pump at the top of a free-standing upright container, usually a cylindrical container with a base in the form of a follower piston which rises up inside the container as the product is depleted so as to keep the system airless. A recent alternative for airless systems is to have paste in a collapsible bag inside an outer container.

The known pump-type dispensers for pastes are undesirably expensive, having numerous components.

SUMMARY OF THE INVENTION

One aspect of the present proposals is a dispenser for dispensing a flowable material from a container. It includes a tube defining a discharge flow channel between

an inlet end and an outlet end. The tube has a resiliently deformable wall, and the dispenser provides for lateral deformation of the deformable wall across the discharge channel to compress the discharge channel laterally and thereby expel material from the outlet end. The dispenser may include an actuator element mounted beside the tube and movable laterally relative to it, e.g. by means of a sliding or pivoted mounting, to engage its deformable wall and compress it sideways.

The deformable wall, and preferably the entire tube wall (circumferentially) may be of resiliently deformable material e.g. elastomer. The thickness and material of the deformable tube wall may be selected, taking account of the viscosity of the material to be dispensed and the flow characteristics upstream, to give sufficient resilience for the restoration of the deformable wall to its rest condition to refill the discharge channel through its inlet portion after each dispensing. It may be a tube of cylindrical cross-section or of other e.g. oblong cross-section; an oblong cross-section enables a higher dose volume for a given operating stroke (along the minor axis).

For efficient operation it is of course preferable that the resistance to forward flow through the outlet be less than the resistance to flow back through the inlet.

For this purpose an inlet valve function is preferably provided. This may use a conventional valve element, e.g. a flow-actuated flap or ball. Such a valve can close in known manner in response to an increase of pressure in the discharge channel. However we prefer to provide the valve function by arranging for a deformable wall portion of the discharge tube, to the upstream of the deformable wall referred to previously, to be displaced (e.g. by the same action that compresses the tube) to wholly or partially block the tube upstream of the compressed region so inhibiting or preventing flow back through the inlet as the tube is compressed.

A preferred way to do this is by arranging for a blocking portion, e.g. a longitudinally-localised lateral projection, of an actuator element as proposed above to move the deformable tube wall at the relatively upstream position in an initial stage of the actuating stroke so as wholly or partially to block off backflow, the remainder of the actuation stroke progressively compressing the tube downstream of the blockage to expel material through the outlet.

Irrespective of whether a block is created towards the inlet side, it is generally preferred that the action of the actuating element(s) is such that at a given stage of the actuating stroke, (preferably for more than half

of its extent) the degree of compression of the tube progressively decreases along it in the downstream direction, favouring forward flow.

This proposal of using deformation of a discharge conduit wall to block an inlet (upstream) portion of a deformable pump chamber or passage at the onset of a pumping stroke, to provide an inlet valve function, is an independent invention proposed herein i.e. proposed irrespective of the particular shape and mode of compression of the discharge channel or pump chamber.

To keep the system airless and for effective priming, a discharge valve function at the outlet end is desirable. Again, for simplicity we prefer this to be achieved by the resilient deformability of the discharge tube wall. Thus, a discharge opening in the form of a slit through the discharge tube wall, and most preferably a forwardly-directed slit on a nozzle tip e.g. a duckbill formation, is convenient and effective.

This slit valve preferably constitutes the final discharge opening of the dispenser.

Drawing these themes together, a preferred version of our proposals is a dispenser, e.g. a dispenser for paste material such as gels and creams as typically used in pharmaceuticals, personal care and food products, having a discharge channel consisting essentially of a

resilient elastomeric tube with an inlet end connected to receive material from a product container, preferably directly i.e. not via any directional inlet valve. It has an outlet end terminating in a tip with a slit-form opening e.g. a duckbill valve. An actuating element is mounted in the dispenser next to the elastomeric tube to be movable in a dispensing stroke laterally relative to the tube, compressing the tube. The actuating element includes a blocking portion towards the inlet end of the tube which moves laterally in advance of other parts of the actuating element to block the tube wholly or partly by squeezing it. The actuating element has a compression region extending downstream relative to the blocking portion, and preferably elongate in the flow direction, shaped and mounted so as to be brought in to press along the side of the tube and squeeze material from the outlet opening.

Preferably such an actuating element is mounted pivotally in the dispenser, e.g. extending downstream along the discharge tube relative to the pivot point. This can encourage an action tending to squeeze material outwardly. Additionally or alternatively, an engagement face of the actuating element may be inclined away from the tube so that compression is initially greater nearer the inlet than nearer the outlet.

The blocking portion of the actuating element may be formed separately from the compression portion that squeezes the product from the tube. Indeed, they may be on elements which are separate but move together. A simple and therefore preferred construction provides the upstream blocking portion and the downstream compression portion on the same component in one piece. This may be a component pivoted towards the inlet end of the discharge channel. Preferably the blocking portion is resiliently retractable relative to the compression portion, so that as the actuating element is pivoted further to deform the tube progressively, the blocking portion does not dig too forcibly into the tube wall and perhaps damage it, and/or hinder further movement of the actuating element.

The dispenser may use one actuating element, preferably with a static reaction abutment supporting the discharge channel from the opposite side, or may use opposed movable actuating elements to squeeze the tube dynamically from opposite sides.

The actuating element(s) may be exposed for direct manual engagement, or may be connected via operating mechanism, e.g. a lever or slider mechanism, to discrete manually-engaged element(s).

The product container (a pack consisting of a dispenser mounted on top of a filled or unfilled container is an aspect of the invention) is preferably of the airless or volume-adjusting kind having a collapsible bag or follower piston. However, other kinds of container may be used. The dispenser may be used either upright or inverted.

An advantage of having a slit or duckbill valve at the outlet is the ability to make a clean cut-off of dispensed products. A duckbill valve has a relatively acute convexity at its tip, leaving little forwardly-directed area for the adherence of dried residues.

Another benefit achievable with this system is that the product need not contact relatively movable discrete parts or metal parts, reducing the likelihood of contamination. Avoiding metal components may also enable recycling.

A further benefit with dispensing through a simple squeezed tube is that, with paste, we find that stripes applied to the paste survive dispensing in good shape, by contrast with piston-cylinder pump dispensers which spoil striping if conventional valves are used. Note that if a one-way follower piston is used in the container (e.g. having a pawl that engages the container wall to prevent

reverse movement), inlet valve function at the dispenser inlet can be omitted altogether.

The dispenser may be provided with a closure component for a container, e.g. a snap- or screw-fit cap, at its inlet end. This may be attached to any suitable container. Indeed, it could be attached to a conventional toothpaste tube in place of its normal screw cap.

The deformable tube may be formed integrally in one piece with a cap or cover to extend over the top of a product container, and optionally including (in one piece) a sealing periphery adapted for sealing engagement around the top of a container, e.g. a cylindrical plastic container.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention are now described by way of example with reference to the accompanying drawings in which

Fig. 1 is an axial cross-section of a dispenser pack embodying the invention;

Fig. 2 shows the Fig. 1 dispenser at the end of a dispensing stroke;

Fig. 3 is an axial cross-section of a second dispenser pack embodying the invention;

Fig. 4(a) shows the top of the Fig. 3 dispenser at the end of its dispensing stroke, while Fig. 4(b) shows a variant construction at the bottom of the pack;

Figs. 5(a) to (d) show an actuating button in top, oblique, side and front views respectively;

Figs. 6(a) and (b) are front and side views of an elastomeric discharge tube unit as seen Figs. 1, 2;

Figs. 7(a) and (b) are front and side views of an alternative embodiment of elastomeric discharge unit;

Fig. 8 is a front oblique view of the dispensing part of the assembly seen in Figs. 3 and 4(a);

Figs. 9 and 10 are axial cross-sections through a third embodiment of dispenser, before and after the dispensing stroke;

Figs. 11 and 12 are schematic axial sections showing a fourth embodiment of dispenser with opposed operating levers, before and after the dispensing stroke (but shown separate from a container);

Figs. 13 and 14 are axial cross-sections of an alternative embodiment of the dispenser pack, without and with a toothpaste tube in place;

Fig. 15 is an exploded view of the components of dispenser pack seen in Figs. 13 and 14;

Fig. 16 is an axial cross-section of an alternative embodiment of the dispenser pack;

Fig. 17 is an exploded view of the components of dispenser pack seen in Fig. 16; and

Figs. 18 and 19 are axial cross-sections of alternative embodiments of the dispenser pack.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to Figs. 1 and 2, a dispenser pack is designed to hold toothpaste in the internal space 8 of a container 1. In this embodiment the container consists of a collapsible impermeable bag 1 enclosed by a rigid plastic shell 1′ with a hole 11 through its base. This is a known mode of containment for viscous products sensitive to air; the bag 1 collapses gradually as product is dispensed while the outer shell 1′ protects and supports it.

A pumping arrangement is secured at the top of the container 1, consisting essentially of an elastomeric discharge tube unit 3 secured over the opening of the container 1, and a housing body 2 which locates and supports the tube unit 3 in relation to the container shell 1′ and a movable actuating button 5 mounted beside the tube unit 3.

The tube unit 3 is shown in isolation in Fig. 6. It is a one piece elastomeric moulding, e.g. of rubber or thermoplastic elastomer, and has a cylindrical side wall 32 which is tilted away from the upright axis of the

dispensing package. The top of the tube converges to a so-called duckbill valve 33, constituted by opposed convergent faces 35 leading to a linear outlet slit 36. In a known manner, this readily opens to allow paste to pass out (arrow A, Fig. 2), but any negative pressure behind the outlet acts, in concert with the material's resilience, to pull the slit 36 firmly shut and make an airtight seal.

The base of the cylindrical tube 32 flares out as an integral annular cap 34 having a peripheral upwardly-opening U-channel 35. In the assembled pack (see Figs. 1, 2) this fits down inside a thickened locating rim 13 of the collapsible bag 1, which in turn fits in a locating groove 12 at the top of the container shell 1'. The lower edge of the body shroud 2 has an annular projection 21 which fits down into the U-channel 35 to lock the assembly together, in combination with a snap engagement between shroud 2 and shell 1'.

This forms a sealed, open communication between the container interior 8 and the cylindrical discharge channel 31 in the elastomeric tube 32, closed at the top end by the slit valve 33.

The body 2 provides a shroud or casing with an eccentric top opening 23 through which the convergent tip of the elastomer tube projects. The body 2 also provides

an inclined interior abutment 26 against which one side of the tube 32 rests. Opposite that abutment the housing or body 2 has a side opening 24 which exposes the actuating surface 51 of the actuating element 5. Looking at Fig. 1, 2 in conjunction with Fig. 5 the actuating element 5 is a one-piece plastic unit, mounted pivotingly through studs 52 to either side of the nozzle unit (see also Fig. 8, showing clips 15 to receive the studs 52 pivotably). The element 5 can then be pivoted by pressing on its actuating surface 51 between the positions shown in Fig. 1 and 2.

The operating (front) surface of the element 5 features two downwardly-dependent limbs 54,57 one behind the other. The front limb 54 presents a generally flat engagement surface 55. The rear limb 57 projects to below the bottom edge of the front limb 54 and carries a forwardly-projecting flange 53. The limbs 54,57 are resiliently flexible relative to one another and to the actuating surface 51. In the rest condition (Fig. 1) the dimensions of the element and the positioning of the pivots 52,15 are such that the forwardly-projecting flange 53 indents a lower part of the elastomeric tube wall 32 as seen in Fig. 1. However the tube channel 31 remains substantially open at this region, and most of the tube interior 31 above is fully open.

As the actuator 5 is pushed forwardly, towards the position of Fig. 2, an initial event is further indentation of the lower part of the tube 32 by the projecting flange 53. Assuming an initial condition with the container and nozzle channel 31 full of paste, the effect of this is to tend to block off the escape route from the discharge channel 31 back into the container space 8. As the button 5 is further advanced, the extent of this blockage increases and at the same time, the front engaging surface 55 of the front limb 57 swings into progressive and compressive engagement with the tube wall 32; the opposing abutment 26 reacts to these forces so that the internal discharge channel 31 is gradually compressed and the nozzle tip 33 keeps its position. The flattening of the channel 31 expels paste from the nozzle tip (arrow A in Fig. 2) until the button 5 reaches the limit of its stroke. During the stroke the force against the end of forward flange 53 causes its supporting limb 57 to deflect back relative to the surrounding parts of the element 5. This flexibility avoids excessive forces being applied against the tube wall and hindering the movement of the button.

When the button is released, the resilient re-expansion of the tube wall 32 pushes the button back to its start position and generates a negative pressure

which draws paste material up into the nozzle space 31 from the container space 8, the bag 1 collapsing slightly to compensate and venting air entering the intermediate space between bag 1 and shell 1' through vent hole 11.

This dispensing action has a number of advantages, in particular the avoidance of any discrete springs or metal parts in the product path, the absence of discrete valve components, but nevertheless a positive pumping action from the valve effect of the flange 53.

Figs. 3 and 4 show some variants, in which the pumping action is the same as in the first embodiment. In the Fig. 3 embodiment the cylindrical elastomeric tube 32 and its duckbill valve 33 are the same as before, but the lower end stops short instead of flaring to form a cap. The container is a rigid plastics container 101 with a sliding follower piston 102 having a sealing lip 103 forming a movable base. The top of the container is closed by a flat top wall 104 having an oblique spigot 105 onto which the bottom end of the cylindrical elastomer tube 32 fits tightly. In this embodiment an abutment structure 126 to support the tube 32 is formed as integral upward projections from the container roof 104; see also Fig. 8 which shows this embodiment. The clips 15 for the pivoting button can be formed also on the roof 104, whereas for the first embodiment they would

project in from the skirt of the housing 2. Note from Fig. 8 that the abutment 126 need not provide an extended surface to support the tube 32 adequately. Here, three edge engagements suffice.

Note also from Fig. 3 that the follower plate has a downwardly-flaring sealing lip 103 which allows minor quantities of trapped air to escape during filling of the pack.

Fig. 4(a) shows the top of the Fig. 3 dispenser at the end of the dispensing stroke. The action is the same as in the first embodiment, except that the tube 32 needs to deform across the top of the spigot 105. In this embodiment the casing 2 is primarily to support the rubber nozzle 33, and for aesthetic purposes.

Fig. 4(b) shows an alternative follower plate construction where the follower plate sealing lips 203 will not allow trapped air to escape and a central vent 205 is provided instead.

Fig. 7 shows an alternative construction of the discharge tube 132, adapted for dispensing a larger volume without increasing the stroke of the actuating element 5. This is done by making the cross-section of the tube 133 generally oblong, with a larger dimension W transverse to the stroke and a smaller dimension D along

the stroke. The nozzle outlet is the same size as before, however.

Figs. 9 and 10 show a further embodiment in which, instead of a swinging button 5 acting against a fixed abutment 26, the dispenser provides a pair of similar pivoted buttons 5 to either side of the discharge tube 32 to act counter to one another. Here, the tube 32 is upright (axial to the container) and the buttons 5 are identical. Such a construction may enable a greater relative displacement of the tube wall by the lower flanges (a more positive inlet valve function) and also a more progressive urging of material along the tube channel 31 in the downstream direction as the elements 5 swing together. The body casing 2 has a pair of corresponding openings 24 to expose the two buttons 5.

Figs. 11 and 12 show a further variant. Here the compressible rubber discharge tube 232 is fitted on a top spigot 205 of a screw cap 206 which can be freely transferred from one container to another, e.g. a conventional toothpaste tube. This embodiment features an indirect drive mechanism for the actuating elements 215. A surrounding casing 202 has an upper pivot 71 at which a pair of opposed actuating levers 7 are pivoted so that they can be swung between the raised and lowered positions seen in Fig. 11, 12. A common lower pivot 215

mounts the bottom ends of a pair of opposed actuating elements 215, each having an inwardly bent supporting arm 256 and a medial forwardly-projecting portion 255 adapted to press the respective side of the tube 232. The initial inclination of the actuating portions 255 brings their lower ends 253 into engagement initially with the lower part of the tube 232 to provide an inlet valve effect by partial blockage at the lower end. The upper ends of the support elements 256 enter recesses in the undersides of the operating levers 7 and are retained there in slide tracks 72 for the necessary freedom of action. The lever mechanism gives a significant mechanical advantage, making this suitable for use by children.

Figures 13, 14 and 15 show a further embodiment, in which the pumping mechanism is different from the previous embodiments. The tube 3, with deformable wall 332 and duckbill valve 333, is the same as before, except the lower end has an annular projection 336. The tube 3 fits tightly over an inner spigot 61 of a container cap 6, with the annular projection 336 of the tube 3 abutting against a flat top portion 62 of the container cap 6. The cap has sidewall 63 with horizontal portions 64 for locating between a rigid container shell 201′ and the housing body 2. The inner spigot 61 has an inner screw

thread 65, dimensioned such as to allow the container cap 6 to directly replace the cap of a squeeze container containing paste or gel, e.g. a conventional toothpaste tube. Figure 14 shows the arrangement with a toothpaste tube 201 in place.

The one-piece movable actuator element 5 of the previous embodiments, with two downwardly dependent limbs 54, 57, is replaced with a laterally movable button 80 and leaf spring 81. The leaf spring 81 has a forwardly projecting flange 83, for indenting the lower part of the deformable tube wall 332, acting as a blocking portion. Situated above this flange 83 is a flat vertical portion 85, for compressing the tube and expelling flowable product through the duckbill valve 333. A horizontal top portion 84 of the leaf spring 81 is slottedly located between two closely spaced projections 801 of the inner wall of the actuating button 80.

Figures 16 and 17 show a further embodiment, in which the pumping action is different again from the previous embodiments. The dispenser structure is mounted on a container having a follower piston 302. When the tube is compressed by actuating a compression member 405, if the force required to open the duckbill valve 433 is less than the force required to push the follower piston 302 backwards, product will be dispensed through the

duckbill opening 436. A specific or discrete blocking portion or inlet valve at the inlet end of the tube 3 is therefore not necessary.

Figures 18 and 19 show further embodiments, in which the tube 3 is formed from a two-shot moulding process and has portions of deformable material X and portions of rigid material Y. The tube comprises a deformable wall 532 of deformable material X. An actuator member 9,9′ is disposed behind the deformable wall 532, for deforming it in a similar manner to that described in the previous embodiments of the invention. A ring-shaped elastomeric member 538 with central hole 5381, and a resiliently biased rigid valve member 539 covering the hole 5381, combine to provide an outlet valve to the tube 3. A duckbill valve as used in previously described embodiments could instead be provided at the outlet end, although it is understood that various other types of outlet valve are acceptable.

The remaining parts of the tube 3, including the flare 534 at the base of the tube 3, are of rigid material Y. Using a two-shot moulding process to produce a tube of this kind is substantially cheaper than producing an entirely elastomeric tube, as elastomeric injection form materials tend to be rather expensive.

Figures 18 and 19 also show variations in construction of the movable actuator element 9,9′ for providing lateral deformation of the deformable wall 532 of the tube 3. In both examples the pivot point 92,92′ of the actuator element is adjacent the outlet end of the tube 3, unlike the embodiments described previously (e.g. Fig 5(c)).

A blocking portion 93,93′ is provided at the bottom of the actuator element for indenting the inlet end of the deformable wall 532 of the tube 3, thus acting as an inlet valve. Figure 18 shows a blocking portion 93 projecting from a flexible semicircular portion 931 of the actuator element 9. The flexibility avoids, in use, excessive forces being applied against the tube wall and hindering full movement of the actuator element. Figure 19 shows the blocking portion 93′ projecting from a flexible tube portion 931′; a variation to the semicircular region 93 described above.

The actuator elements of Figures 18 and 19 have different structures. Figure 18 shows an actuator element 9 with an arcuate compression portion 95 that, as it rotates around the pivot point 92, pushes a flexible projection 94 that extends from the rigid flare 534 at the base of the tube 3 such that its flat front facet 96 lies against the deformable wall 532 of the tube 3. Such

a construction enables a progressive urging of material in the downstream direction.

The actuator element shown in Figure 19 comprises, as a compression portion, a flexible limb 95′ extending upwardly from an upstream region, with a flat front facet 96′ for engagement with the deformable wall 532 of the tube 3 as the actuator element rotates around the pivot point 92′. Such a construction again enables a progressive urging of material in the downstream direction.